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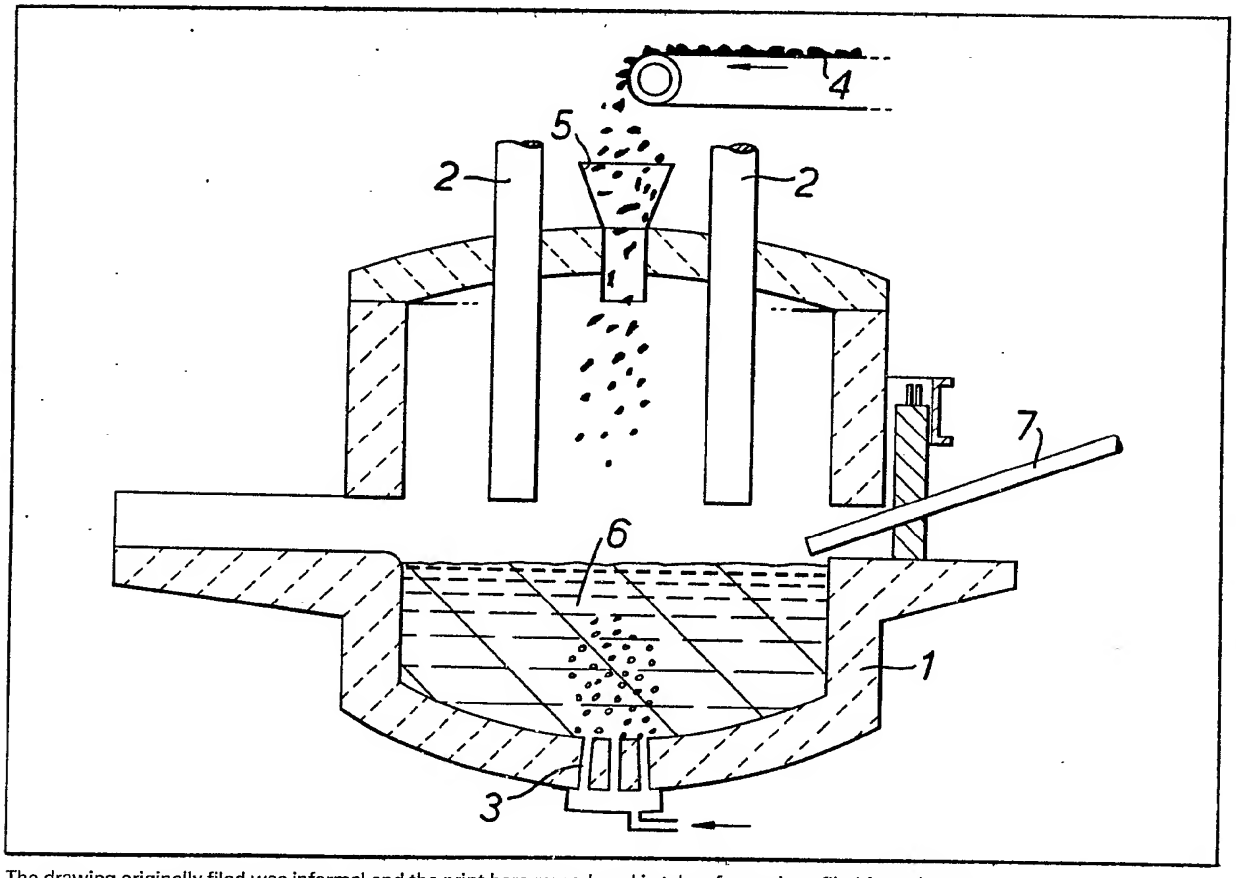
(54) Improvements in or relating to a process for melting and/or refining steel

(57) The invention provides a process and apparatus for melting and/or refining steel in an arc furnace (1) comprising the steps of providing a steel melt (6) in the furnace; injecting a stirring or processing gas (3) directly into the steel melt from below the surface of the melt therein; introducing solid carbonaceus material (5) from above onto or through the upper surface of the melt in the refining vessel; and introducing oxygen (7) into the vessel.



The drawing originally filed was informal and the print here reproduced is taken from a latzr filed formal copy.

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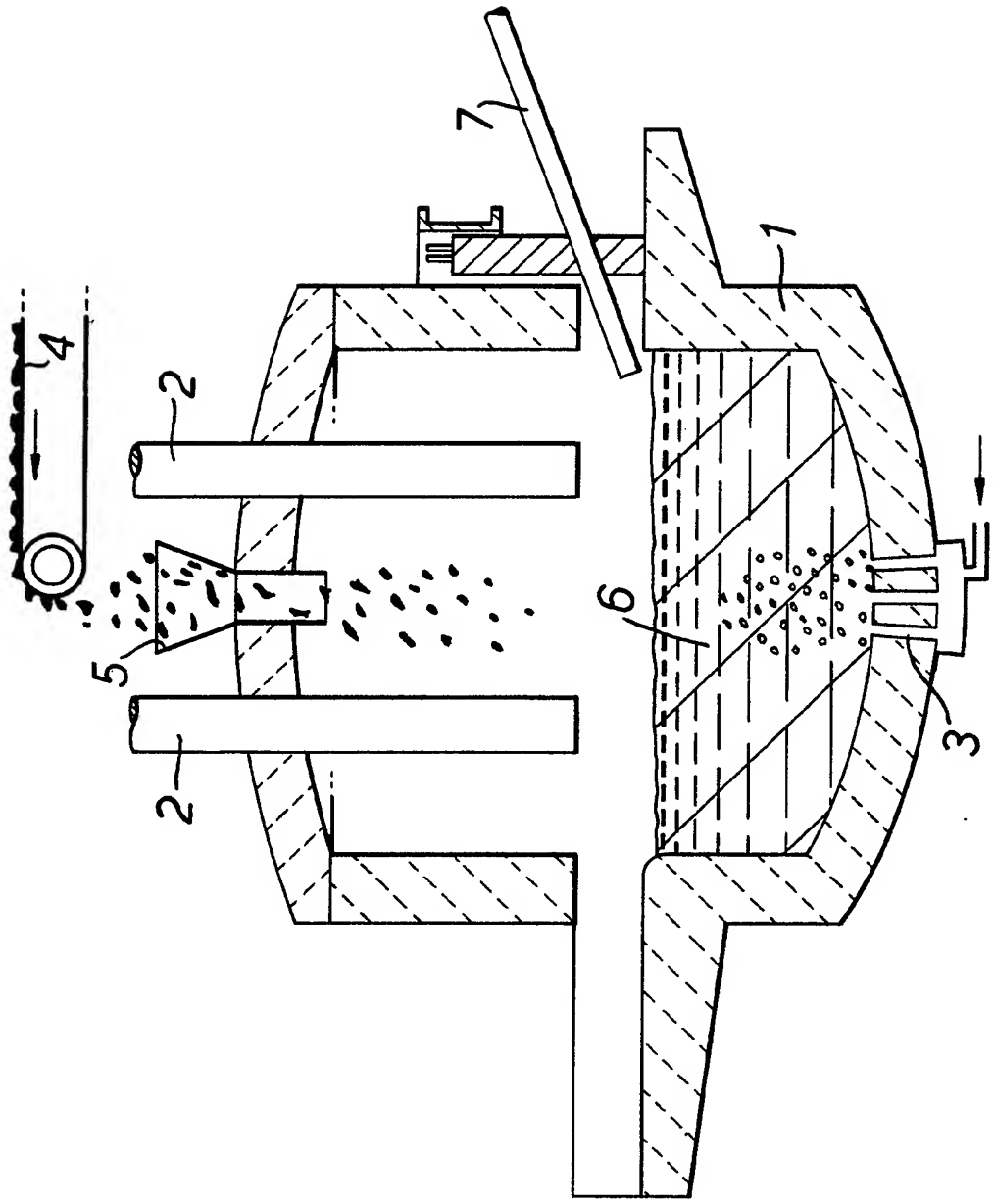

SPECIFICATION

Improvements in or relating to a process for melting and/or refining steel

This invention relates to a process for melting and/or refining steel.

According to the invention there is provided a process for melting and/or refining steel in an arc furnace including the steps of providing a steel melt in the furnace; injecting a stirring or processing gas directly into the steel melt from below the surface of the melt therein, introducing solid carbonaceous material from above onto or through the upper surface of the melt contained in the vessel, and introducing oxygen into the vessel.

The source carbonaceous material may be of any convenient kind. Thus it may comprise anthracite, coal, lignite or other carbon bearing material such as silicon carbide or calcium carbide. The carbonaceous material may be introduced in granular, pellet, lump, briquette or similar form by means of a hopper of the kind normally used for additives to a refining vessel. Thus a coal or coke may be introduced from such a hopper. Again silicon carbide coke (i.e. Silicon carbide together with free carbon) may be introduced from a hopper. In some embodiments hopper feed may be used for the continuous introduction into the vessel of coal or coke together with steel scrap and/or pre-reduced iron.

Alternatively the carbonaceous material may be blown onto or through the upper surface of the melt in granular or powder form via a carrier gas. This blowing may provide penetration of the material into the melt.

In one embodiment, lance blowing of the carbonaceous material may be by means of a high velocity carrier gas. In this embodiment it is intended to achieve the maximum possible carbon penetration of the melt before reaction of the carbon occurs.

Alternatively the blowing may comprise little more than gas assisted flow, for example of particulate or lump feedstock through a supply pipe.

Oxygen may be introduced into the vessel via an overload lance, and this lance or a subsidiary lance may be used for transportation of the carbonaceous material with one of, or a mixture of, a variety of carrier gases such as nitrogen, argon or other inert gas; air, or cabon dioxide; or a reducing gas such as carbon monoxide.

The lance may have a single outlet orifice or a plurality of orifices.

Blowing of carbon by a lance may be from an upper opening of the vessel, or alternatively through tuyeres which may project through ports in the walls of the vessel.

In order to improve or maximise assimilation of the carbonaceous material into the melt, the entraining gas may be arranged for a pulsed form of actuation, or a swirling actuation may be arranged to give a required spread of material over the upper surface of the melt.

The stirring or processing gas may be inert such as Nitrogen or Argon, or may be active such as air or carbondioxide, or a mixture of these gases.

With the process of the kind described, the stirring or processing gas may be injected into the melt by any suitable means such as by means of porous bricks or by means of one or more tuyeres in the bottom or side walls of the vessel. In this latter case the tuyeres may at times be used to entrain solid reactants such as lime in powder and granular form for processing purposes. In one embodiment of the invention, additional carbon may be injected.

Alternatively, or additionally, to the introduction of oxygen into the vessel by means of an overhead lance, oxygen may be introduced by means for example, of a lance projecting into the melt or by means of tuyeres in the bottom or side walls of the vessel, and in some instances may constitute or form part of the stirring or processing gas.

In one embodiment of the invention an injection lance for carbonaceous material (utilising a carrier gas) may be associated with an oxygen lance. Thus for example the two lances may be disposed side by side, or alternatively may be separate parts of a double coaxial lance, the inner part being used for the oxidising gas, whilst the annular part is used for the carbonaceous material and its carrier gas.

Such lances may be formed by consumable pipes, these being of particular value where the stirring of the melt is carried out at least in part by the oxygen. In this case as the lances for the carbonaceous material and its carrier gas, and for the oxygen, are consumed they can be fed towards the melt.

We have found it convenient and beneficial to commence utilisation of the invention during the melt down operation of the arc furnace. By this means carbon combustion also occurs in the interstices of the scrap network, leading to improved heat transfer and an increased percentage in combustion through to carbondioxide.

The invention includes apparatus for carrying out the process hereinabove specified.

In order that the invention may be more readily understood one embodiment thereof will now be described by way of example with reference to the accompanying drawing which is a schematic elevation of an arc furnace incorporating the invention.

In the embodiment of the invention illustrated an electric arc furnace 1 has the usual electrodes 2. Basal tuyeres 3 are provided for the introduction of a stirring gas, such as an inert gas. An overhead conveyor 4 and hopper 5 arrangement are provided by means of which coal together with scrap and prereduced iron and granulated iron can be added to the top of the melt 6 in the furnace. A lance 7 projects through the side of the furnace for the introduction of oxygen.

By means of the invention we provide a surprisingly efficient means of achieving recovery of heat, which can be used to enable a significant

reduction in electrical requirements for melting solid ferrous bearing material. In addition carbon content control is greatly enhanced.

The process according to the invention may be carried out concurrently with arc operation in the furnace, or may be carried out sequentially therewith, for example in an intermittent mode.

CLAIMS

1. A process for melting and/or refining steel in an arc furnace comprising the steps of providing a steel melt in the furnace; injecting a stirring or processing gas directly into the steel melt from below the surface of the melt therein; introducing solid carbonaceous material from above onto or through the upper surface of the melt in the refining vessel; and introducing oxygen into the vessel.

2. A process according to Claim 1 wherein the stirring or processing gas is an insert gas.

3. A process according to Claim 1 or 2 wherein the solid carbonaceous material comprises a coal or coke.

4. A process according to Claim 3 wherein the solid carbonaceous material comprises an anthracite.

5. A process according to Claim 1 or 2 wherein the solid carbonaceous material comprises a carbon containing compound.

6. A process according to Claim 1 or 2 wherein the solid carbonaceous material comprises a carbon containing industrial byproduct.

7. A process according to any one of the preceding claims wherein the solid carbonaceous material is introduced to the melt by means of a hopper or chute.

8. A process according to any one of Claims 1 to 6 wherein the solid carbonaceous material is introduced to the melt by means of a pipe with gas assistance.

9. A process according to any one of Claims 1 to 6 wherein the solid carbonaceous material is introduced to the melt in granular or powder form in a carrier gas blowing with sufficient velocity to provide penetration of the material into the melt.

10. A process according to Claim 9 wherein a lance is used for the carbonaceous material injection.

11. A process according to any one of the preceding claims wherein a lance is used for the introduction of oxygen.

12. A process according to Claim 11 as dependent on Claim 10 wherein the carbonaceous material lance is physically associated with the oxygen lance.

13. A process according to Claim 12 wherein the two lances are disposed side by side.

14. A process according to Claim 12 wherein the two lances are arranged as separate parts of a double coaxial lance.

15. A process according to any one of the preceding claims wherein operation commences during the melt down operation of the arc furnace.

16. Steel refining apparatus for carrying out the process according to any one of the preceding claims.

17. A process for refining steel substantially as hereinbefore described with reference to the accompanying drawing.

18. Steel refining apparatus substantially as shown in and as hereinbefore described with reference to the accompanying drawing.

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